MODELLING CREDIT CYCLES

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PREPARED FOR THE IGIER 20TH ANNIVERSARY CONFERENCE,

MILAN 8-9 JUNE 2011

IGIER and APPLIED THEORY

One major achievement of IGIER over the last 20 years has been to produce important contributions to Applied Theory in many domains of Economics :

- Fiscal policy
- Monetary policy
- Labor markets
- Political economy
- Market microstructure,...

To illustrate current challenges in Applied Theory, I have chosen a topic closer to my domain of expertise, namely

applications of contract theory to banking regulation.

INTRODUCTION

- In the domain of banking regulation, Economic Theory is currently on demand by public authorities, a situation that is rather unusual.

- Following the subprime crisis, new forms of public intervention are being considered, called macro-prudential regulations.

- Regulators turn towards academics to know whether there is a sound theoretical foundation for such new forms of bank regulations.

INTRODUCTION (2)

- More precisely, regulators claim that banks lend too much during booms and too little during recessions.
- They envisage new regulatory tools aimed at dampening these "credit cycles": e.g., countercyclical capital requirements for banks.
- My focus today: what Economic Theory tells us about credit cycles and possible justifications for public intervention.

PLAN OF THE PRESENTATION

I will analyze three theoretical mechanisms that could generate credit fluctuations:

1. Collateral constraints
2. Credit reversals
3. Pecuniary externalities
4. Wrap-up and policy implications
5. Conclusion

1. Collateral constraints

- Kiyotaki- Moore (1997) show how small, temporary productivity shocks can generate large, persistent fluctuations in output and asset prices.

- Main mechanism: dual role of durable assets (land, capital)= production factor +collateral for loans.

- When borrowers are credit constrained, a negative shock can force them to sell assets, provoking a deflationary spiral.

1 . Collateral constraints (2)

Basic model: no uncertainty.

2 goods: land (fixed total endowment 1), price q_t .

fruit (perishable) price 1.

2 sectors: farmers $y_t = ak_t$, gatherers $y_t' = G(1-k_t)$

Farmers want to leverage but cannot pledge their future income. Borrowing limit = discounted resale value of their land holdings. Their budget constraint is:

$$q_t k_t = ak_{t-1} + \frac{q_{t+1}k_t}{1+r} \Leftrightarrow ak_{t-1} = (q_t - \frac{q_{t+1}}{1+r})k_t$$

farmer's income borrowing limit usage cost of land

1 . Collateral constraints (3)

At equilibrium, usage cost of land equals its marginal productivity in the gathering sector:

$$u_t \equiv q_t - \frac{q_{t+1}}{1+r} = \frac{G'(1-k_t)}{1+r}$$

Equilibrium dynamics of farmers' land holdings:

$$ak_{t-1} = \frac{k_t G'(1-k_t)}{1+r} \equiv k_t u(k_t)$$

Unique steady state defined by: $ak^* = k^* u(k^*)$

1 . Collateral constraints (4)

Suppose the economy has reached the steady state k^* and consider a single (unanticipated) productivity shock Δa at date t.

This shock has an immediate impact on land price (at date t) and thus on the borrowing capacity of farmers

$$(a + \Delta a + q^* + \Delta q_t)k^* - q^* k^* = u(k_t)k_t$$

Linearize around the steady state k^* and denote by η the elasticity of u :

$$(\Delta a + \Delta q_t)k^* = u(k^*)(1+\eta)\Delta k_t \text{ at date } t$$

$$\text{and } a\Delta k_{t+s-1} = u(k^*)(1+\eta)\Delta k_{t+s} \text{ for } s \geq 1$$

1 . Collateral constraints (5)

Thus the unanticipated shock is persistent, and it is amplified by the change in asset prices.

The mechanism is similar to the credit multiplier effect identified by Bernanke and Gertler (1989).

However:

- The capital of banks does not play any role (there are no banks!)
- The results disappear if debt can be indexed (see later)
- Finally, additional features are needed to generate cycles.

2.Credit reversals

Myerson (2010) develops an alternative framework, related to Suarez and Sussman (1997) and Matsuyama(2004), where cycles appear naturally, due to credit reversals.

Myerson's model (simplified):

One good (grain), can be invested or consumed.

Farmers need to borrow from bankers, who must be given the incentives to select the farms that have a high probability α of success (moral hazard) .

Bankers live $n=2$ periods and sign contracts with investors, specifying the size of the bank and the payments to the banker, as a function of outcomes.

No discounting, universal risk neutrality.

2. Credit reversals (2)

Unit yield of good farm (equilibrium ROA of each bank):

r(I) with probability α (and zero otherwise)

decreases with the total size *I* of the farming (and banking) sector. No aggregate risk.

Optimal contract for bankers born at date *t*:

- Banker is only paid at *t+2* if her two successive investments have succeeded.
- Bank liquidated at *t+1* if first investment fails.
- Bank allowed to grow at *t+1* if first investment succeeds.

2. Credit reversals (3)

Since the banker is only paid at the end, incentives can be maintained only if:

- each successful bank is allowed to grow by a factor $\frac{1}{\alpha}$
- each banker that has succeeded twice receives at the end a bonus equal to *B* times the (final) size of her bank.

Net expected ROE of a bank created at date *t*:

$$\alpha\, r(I_t) + \alpha^2 [\frac{r(I_{t+1}) - B}{\alpha}]$$

With free entry and CRS at the individual level, this ROE must be zero.

2. Credit reversals (4)

The equilibrium condition is, for all t :

$$r(I_t) + r(I_{t+1}) = B$$

It expresses that total return on investment (over the two periods) must be equal to the expected bonus that will be paid to the banker.

This obviously generates stable 2-cycles (unless the economy starts in the unique steady state):

$$r(I_{t+2}) = B - r(I_{t+1}) = r(I_t)$$

2. Credit reversals (5)

Source of credit reversals:

- Investors sign 2 period contracts with bankers.
- Equilibrium condition implies that if they get a low return at date t, they must get a high return at date t+1 (and vice versa).

But these credit reversals disappear if bankers have positive endowments (capital) ω.

2. Credit reversals (6)

When banks have capital ω, equilibrium condition becomes:

$$\omega = \alpha k_t [B - r(I_t) - r(I_{t+1})]$$

where k_t is the size of banks newly created at date *t*.

Two cycles disappear!

$$\omega = \alpha k_{t+1} [B - r(I_{t+1}) - r(I_{t+2})]$$

$$I_{t+2} = I_t \Rightarrow k_{t+1} = k_t \text{ (steady state)}$$

3. Pecuniary externalities

Gersbach and Rochet (2011): model with fully anticipated (and insurable) aggregate shocks where banks indeed lend too much during booms and too little during recessions.

The competitive equilibrium is (constrained) inefficient because banks do not internalize the impact of their investment decisions on asset prices, thus generating a **pecuniary externality**.

Efficiency can be restored if banks are subject to a contra-cyclical lending limit.

3. Pecuniary externalities (2)

The model:

One factor (capital) in fixed total amount 1,

one consumption good (numéraire), 3 dates, *2* sectors:

- **Sector B**: firms must be monitored by **banks,** who may also shirk (moral hazard**)**. Return on assets = $z\tilde{R}$
  z= aggregate risk (H or L)
  $\tilde{R}$ =idiosyncratic risk (success or failure).

  Total assets of the banking sector = K.
- **Sector F**: firms that can directly access **financial markets.** Aggregate output *G(1-K)*.

3. Pecuniary externalities (3)

Timing:

At *t=0*, investors sign contracts with bankers

At t=1, macro shock z observed, k(z) invested by each bank.

At t=2 output is shared between investors and bankers.

Rates of return:

Investors are risk neutral and can finance the banks and/or the F-firms: same expected return

$$E[\{k(z)-\omega\}q(z)] = E[k(z)\{z\overline{R} - B\}] \quad (1)$$

q(z) = price of capital in state z;

B =bonus paid to the banker (per unit of size).

3. Pecuniary externalities (4)

- Optimal contract for financing the banks maximizes bankers surplus *E[k(z)]B* under constraint (1).

$$E[\{k(z)-\omega\}q(z)] = E[k(z)\{z\overline{R} - B\}] \quad (1)$$

- Equilibrium price of capital in state z satisfies

$$q(z) = G'(1-K(z))$$

Aggregate credit K(z) obtained by adding up individual financing constraints of banks

$$E[\{K(z)-W\}q(z)] = E[K(z)\{z\overline{R} - B\}] \quad (2)$$

3. Pecuniary externalities (5)

- It is easy to see that the competitive allocation maximizes social surplus under this constraint:

$$MaxE[z\overline{R}K(z)+G(1-K(z))]$$

$$s.t.E[\{K(z)-W\}q(z)]=E[K(z)\{z\overline{R}-B\}]$$

- By contrast, a social planner would recognize the impact on investment on asset prices and would maximize social surplus under a different constraint:

$$MaxE[z\overline{R}K(z)+G(1-K(z))]$$

$$s.t.E[\{K(z)-W\}G'(1-K(z))]=E[K(z)\{z\overline{R}-B\}]$$

3.Pecuniary externalities (5)

- If regulation forces banks to lend less during booms, they will lend more during recessions, increasing expected output and social welfare.
- The competitive equilibrium is not constrained efficient, because banks do not internalize the impact of their investment decisions on asset prices.
- This pecuniary externality is similar to the notion of asset fire sales: if all distressed banks are forced to sell assets at the same time, this will generate a deflationary spiral. However the mechanism is symmetric: it also explains credit booms, without resorting to irrational exuberance.

4. Wrap-up and policy implications

- Kiyotaki and Moore (1997): essentially a model of the credit multiplier, useful to explain the role of financial imperfections in the amplification and persistence of real shocks, rather than credit cycles.
- Moreover, Krishnamurthy (2003) has shown that if borrowers can insure these shocks through contingent debt and financial derivatives, cycles disappear in the KM model.
- Thus the KM model applies more for small borrowers:
  - do not have access to financial derivatives,
  - cannot pledge their future income,
  - borrowing capacity is entirely determined by future resale value of assets (see the empirical work of Monacelli (2006) on real estate prices and household borrowing capacity).

4. Wrap up and policy implications (2)

- As argued by Myerson (2011), borrowing capacity of **banks** is (also) largely determined by their expected future income.
- This feature naturally generates deterministic credit cycles: equilibrium conditions imply negative autocorrelation of credit growth.
- However in the absence of real shocks, introducing bank capital completely eliminates these deterministic cycles.

4. Wrap-up and policy implications (5)

- In Gersbach and Rochet (2011) we introduce real macro shocks in a banking model à la Holmström and Tirole (1997)
- We find that banks react too much to these real shocks (excessive volatility of credit growth and asset prices).
- In the absence of regulation, banks amplify real fluctuations. So there are no deterministic cycles like in KM or Myerson (2010), but rather excessive reactions of bank lending to real shocks.

4.Wrap-up and Policy implications (5)

- A countercyclical capital requirement is a useful regulatory tool, because it limits welfare decreasing pecuniary externalities.
- These externalities are also present in the KM framework (Jeanne and Korinek, 2011): robust feature of credit cycles models.

5 CONCLUSION

- Bernanke Gertler (1989) and Kiyotaki and Moore (1997) have had a major influence on the development of macro-models incorporating financial imperfections, in the form of collateral constraints.
- These macro models are used by central banks for simulating the impact of monetary policy decisions on credit and output.

5.CONCLUSION (2)

- If new regulatory tools such as countercyclical capital requirements are to be used, it is urgent to develop models allowing to simulate the impact of these policy instruments on credit and asset prices.
- In such models, the borrowing capacity of banks should be determined by the value of their equity (liability) rather than by the value of their collateral (asset) as in KM.
- In any case, whatever the form of credit constraints, the presence of pecuniary externalities seems to be robust, justifying some form of public intervention.